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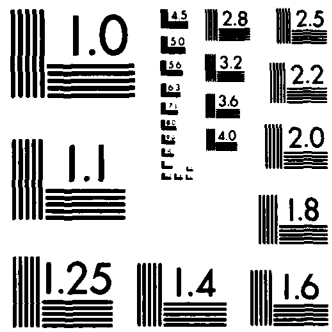

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Apparatus was constructed for the study of pursuit tracking in rhesus monkeys. Two rhesus were trained to track successfully a target moving at 5 milliradians (mrad) per sec (0.29 deg per sec) with an accuracy of ± 7.5 mrad (0.43 deg) for 20 sec. For one monkey, vision was occluded for 1, 2, or 3 sec during a tracking trial. Tracking continued within 7.5 mrad from 0.48 to 3.24 sec.

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M-BLASER: A DEVICE TO STUDY PURSUIT TRACKING IN THE RHESUS MONKEY

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M-BLASER: A device to study pursuit tracking in the rhesus monkey.
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M-BLASER: A device to study pursuit tracking in the rhesus monkey.

Much of laser safety research addresses the determination of ophthalmoscopic and histopathologic ED_{50}s (effective dose with 0.5 probability of observing ocular damage) in non-human primates. These ED_{50}s combine with a safety margin to form the basis for the maximum permissible exposure (MPE) for humans (1). Visual performance after laser exposure is a separate question. A comparison of long-term vision changes can be made by exposing the eyes of an anesthetised animal to laser light. However, to determine the immediate effects of lasers on vision or visual performance it is necessary to expose the eyes of an alert animal to the laser and to measure the animal's performance immediately after exposure. Immediate effects of laser exposure on visual-evoked cortical potentials (2), visual acuity (3), and contrast sensitivity (4) have been assessed. Although these effects have been measured (3,4), it is difficult to predict from this information the effect of laser exposure on a soldier's performance in typical military tasks such as aiming and tracking. Performance of these tasks requires integration of visual and motor skills. Kruk et al (5) reported that performance in a simulator correlated with both manual tracking and visual ability. In our laboratory a tank-tracking simulator (BLASER) was built. It is being used to study human tracking performance in the presence of incoherent light flashes (6). A similar paradigm for an animal model (M-BLASER) would permit us to evaluate performance of a visuomotor tracking task after exposure to coherent light.

The rhesus monkey (Macaca mulatta) is a good animal model for visual performance studies because the visual acuity of rhesus monkeys is similar to that of man (7,8) and the susceptibility of man and rhesus to laser radiation is comparable (9). Rhesus can be trained to perform pursuit tracking (10,11). In compensatory tracking, the performance of rhesus is similar to human performance (12).

The pursuit tracking paradigm we used for rhesus monkeys has two goals: first, to examine the degree of similarity of rhesus pursuit tracking to human pursuit tracking; second, to evaluate the effects of flash on tracking performance.

The effect of flash on performance in the battlefield is important. Various sources, such as high intensity search lights, pyrotechnics, and laser light, may present a flash to a soldier performing a visuomotor tracking task. The question is: Does such a flash disrupt the soldier's tracking performance? Flash effects consist of two components: a startle effect and visual degradation.

The degradation of visual cues can be studied separately by occluding the visual pathway and quantifying the resulting behavioral alteration. We trained two rhesus monkeys and demonstrated effects of vision blocking. The paradigm was practical. Further validation of the paradigm can be achieved by comparing rhesus and human performance in M-BLASER.

TRAINING METHODS

Subjects. Two male rhesus monkeys approximately five-years-old (weighing 8.0 and 9.8 kg) were trained.

Apparatus. A standard Lehigh Valley monkey restraint chair was used. This chair was placed inside a primate cubicle with the door removed. The tracking device in front of the monkey was a light with a viscous-damped mount on a tripod. A viscous-damped mount was used so that kinesthetic (13) cues would be similar to those in a military tracking device. The light source was controlled by a handle which extended to the primate chair. A white background screen 140 cm wide and 76 cm high (471.2 mrad by 256 mrad or 27.0 deg by 14.7 deg) was placed 300 cm in front of the monkey. A dark circular target moved linearly against the white background at a constant speed of 5 mrad per sec (0.29 deg per sec) (Fig 1). The target subtended 57.6 mrad (3.3 deg). The light source overlapped the target by 15 mrad (0.86 deg). Photodetectors at the edge of the target determined the "on-target" condition. The output of the photodetectors was connected through digital interface logic to a microprocessor. The microprocessor provided control over reinforcement in accordance with the percent time on-target and total time on-target requirements. Liquid reinforcement (Tang) was provided from a solenoid controlled reservoir through a drinking tube attached to the restraint chair. A blocking plate and sighting tube were attached to the cubicle to restrict the field of view to being slightly larger than the background screen. Tracking performance was recorded on videotape with a camera attached to the tripod. Off-line analysis was made at 0.25-sec intervals by using a Heath H-8 microprocessor and interface board as previously described (14). Programs for the experimental control, data reduction, plots, and analyses are given in the Appendix.

Procedures. Both animals were adapted to the restraint chair. Before the sta t of training animals were placed in the restraint chair in the cubicle for several sessions of adaptation to this experimental situation. During these adaptation sessions liquid reinforcement (Tang) was provided to the animal at random intervals. This allowed the subject to associate the sound of the reinforcement solenoid with the presence of the reward. The animals were trained to grasp, then move the handle with a slow uniform movement. Standard shaping procedures with positive reinforcement were used. At that time the tracking stimuli were not present.

During the next phase the animals were trained to place the aiming light over the stationary target. Discrete trials were used and the target was positioned randomly for each trial. When the subject placed the light over the target the trial was completed. The animal was rewarded with Tang. If the light was not placed over the target within 60 sec the trial was terminated. Twenty five trials were given each session. After 5 sessions the subjects were successfully placing and holding the pointer on target for 0.5 sec. With additional training the time on target was gradually extended to 10.0 sec.

Then animals were trained to track with the target moving at 5 mrad per sec (0.29 deg per sec). Twenty five trials per session were given. To complete the trial sucessfully the animal had to keep the pointer on target for the required time. If the correct response was not obtained within 60 sec the trial was terminated. Initially the subject was required to be on target for 3 sec. The on-target time requirement was gradually increased over sessions to more than 20 sec. When the animal was tracking successfully for 20 sec the vision blocking plate, beam splitter, and Uniblitz shutter were added (Fig 2). Figure 3 shows typical error for an animal in the early stages of training. At this point in training, reinforcement was presented after 4.5 sec of tracking. Figure 4 shows tracking error for an animal in the later stages of training. For this trial, reinforcement was presented after 21.3 sec of tracking. In Figure 4 the error appears both reduced and smoother.

With the behavior established the effects of environmental manipulations, such as vision blocking and flash, were measured.

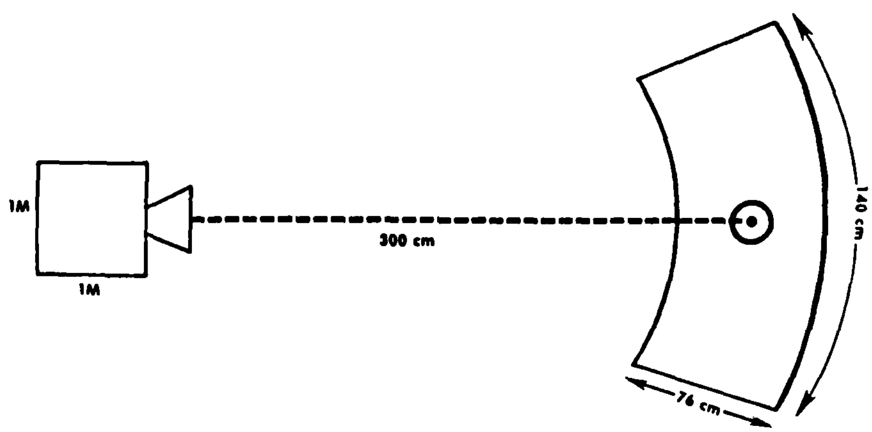


Figure 1. Floor plan of experiment: Monkey cubicle with view limited, target with background screen.

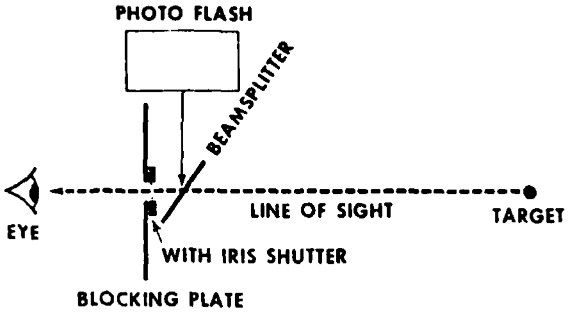
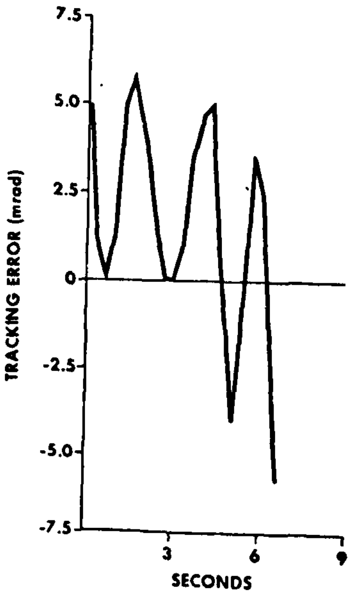
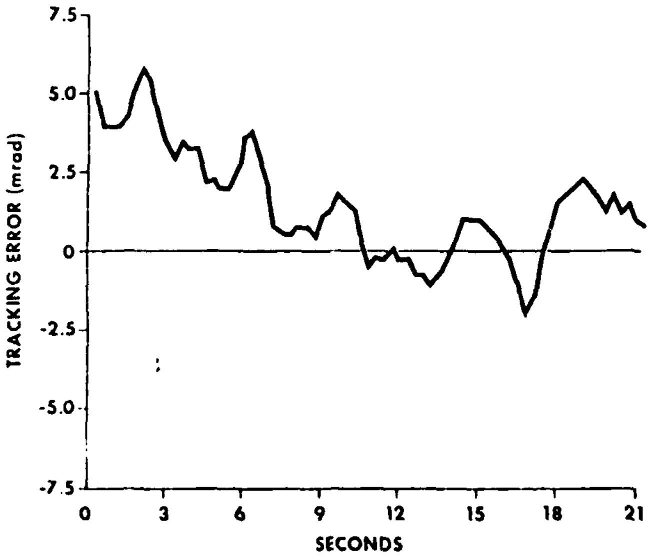


Figure 2 (above). Optical path.

Figure 3 (right). Tracking at early stage of training.

Figure 4 (below). Tracking at a later stage of training





VISION BLOCKING DEMONSTRATION

According to Landis and Hunt (15), there seem to be two stimulus dimensions that contribute to startle: surprise and intensity. Both flash and vision blocking may be presented unexpectedly and therefore have a surprise component. Both flash and reduction in illumination have signal value (16). However they differ in intensity of stimulation. Flash is an increase in visual stimulation. The more intense the stimulation the more pronounced the startle reaction (15). Vision blocking produces a decrease in visual stimulation. Therefore vision blocking would be expected to have less of a startle effect.

METHODS

Subject One male monkey approximately five-years-old and weighing approximately 8.5 kg was used in this demonstration.

Apparatus The equipment was the same as described in Training Methods. The Uniblitz shutter was used to obstruct the monkey's vision through the vision-blocking plate.

Procedure After establishing consistent tracking performance, the shutter was removed from the blocking plate and located temporarily where it could not be seen. The shutter was activated to habituate the animal to the sound of the shutter closing, first while the animal was sitting quietly, later during pursuit tracking trials. After adapting the animal to the sound of the shutter, it was reinstalled.

The shutter was closed on two trials chosen at random. At least two normal trials separated the shuttered trials. During the first two sessions the shutter was closed for 1 sec. For sessions three and four the shutter was closed for 2 sec at a time. For sessions five and six the shutter was closed for 3 sec.

During tracking the monkey was required to track within ± 7.5 mrad (0.43 deg). Error exceeding this was defined as "off-target". The monkey normally tracked for more than 20 sec without going off target. The tracking error was measured by recording both the latency to and duration of the off-target condition. Latency is defined as the time from the closure of the shutter until the monkey goes off target. The duration of the off-target tracking is the time from which tracking first exceeded the ± 7.5 mrad error limit until tracking returned to within the ± 7.5 mrad error limit and was followed by at least 6 sec of on-target tracking.

RESULTS

The values for four shuttered trials for each of the vision blocking times are presented in Table 1. For the 1-sec shuttered trials, the monkey only went off target on the first trial. The

Table 1. LATENCY AND DURATION OF OFF TARGET ERROR

1-SEC VISION BLOCK		2-SEC VISION BLOCK		3 SEC VISION BLOCK	
Latency	Duration	Latency	Duration	Latency	Duration
0.77	2.23	*	0	*	0
*	0	*	0	3.24	1.08
*	0	1.81	1.55	0.48	5.19
*	0	1.44	2.16	2.88	1.80

* indicates did not go off target

monkey went off target after the shutter had been closed for 0.77 sec. Samples of tracking with vision blocked for each time are given in Figure 5. If the monkey merely stopped tracking, the mathematically expected time until he goes off target is 1.5 sec. The median time to go off target for the 3 sec vision blocking was 2.49 seconds which is larger than the expected 1.5 sec, but this difference was not significant ($p > .05$).

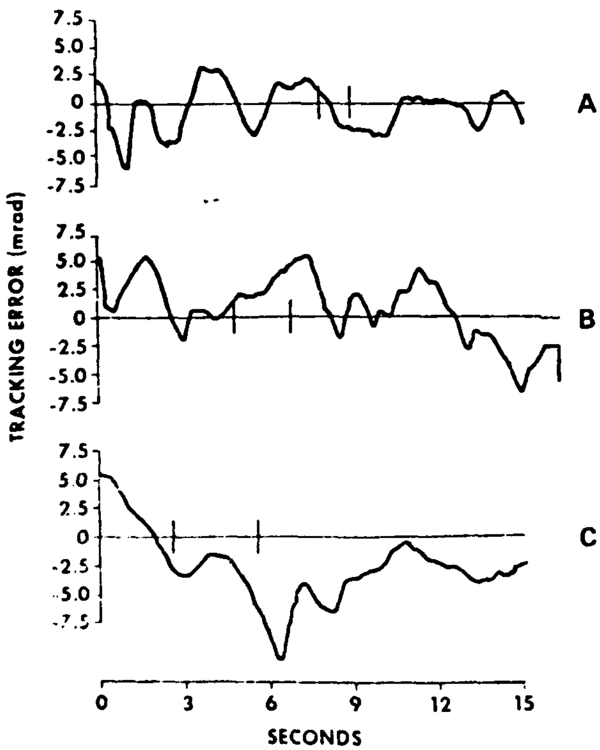


Figure 5 (left). Tracking with vision blocked. Vertical lines indicate closure and opening of shutter.

A = vision blocked for one second

B = vision blocked for two seconds

C = vision blocked for three seconds

COMMENT

A paradigm for training monkeys to perform pursuit tracking allowed evaluation of the effect of manipulations such as flash (17) and vision blocking. In vision blocking the visual cues are removed but the kinesthetic cues remain intact. With vision blocking there is no observable startle effect in either behavior or tracking. However flash can produce startle (15,17). Thus the effects of flash and vision blocking may differ.

The data from our demonstration monkey suggest that vision blocking produced little or no startle effect. Extrapolating information obtained from vision blocking, either total or foveal, to predict the effects of flash may not be appropriate.

CONCLUSION

These data illustrate the practicability of using the experimental paradigm.

RECOMMENDATION

Further validation of M-BLASER could be achieved by comparison of human and rhesus pursuit tracking in the same paradigm.

REFERENCES

1. American National Standards Institute. American National Standard for the safe use of lasers, Z136.1, New York, 1980

2. Randolph DI, Schmeisser ET, Beatrice ES. Grating visual evoked potentials in the evaluation of laser bioeffects: twenty nanosecond foveal ruby exposures. Am J Optom Physiol Opt 1984;61:190-195

3. Zwick H. Laser exposure and visual function. In: Beatrice, ES., ed. Combat ocular problems. Presidio of San Francisco, CA: Letterman Army Institute of Research, October 1980:33-39.

4. Zwick H. Experimental assessments of functional changes in the non-human primate eye following acute laser exposure. In: Beatrice ES, Penetar D, eds. Handbook of laser bioeffects assessment (U), Volume 1: Bioeffects data. Presidio of San Francisco, CA: Letterman Army Institute of Research, February 1984:55-66.

5. Kruk R, Regan D, Beverley KI, Longridge T. Flying performance on the advanced simulator for pilot training and laboratory tests of vision. Hum Factors:1983;25:457-466

6. O'Mara PA, Stamper DA, Beatrice ES, Lund DJ, Jones RL, Serenbetz R, Hannon JP. BLASER: a simulation for the investigation of biomedical factors influencing laser designator operator performance. Presidio of San Francisco, CA: Letterman Army Institute of Research, 1981. LAIR Institute Report No. 90.

7. Weinstein B, Grether WA. A comparison of visual activity in the rhesus monkey and man. J Comp Psychol 1940;30:187-195.

8. Cavonius CR, Robbins DO. Relationship between luminance and visual acuity in the rhesus monkey. J Physiol (London) 1973;232:239-246

9. Stuck B. Ocular susceptability to laser radiation: human vs. rhesus monkey. In: Beatrice ES, Penetar D, eds. Handbook of laser bioeffects assessment (U), Volume 1: Bioeffects data. Presidio of San Francisco, CA: Letterman Army Institue of Research, February 1984:67-83

10. Brooks VB, Reed DJ, Eastman MJ. Learning of pursuit visuo-motor tracking by monkeys. Physiol Behav 1978;21:887-892

11. McCoy DF, Aeschleman GB, Nallan GB, Pace GM. Comparison of two techniques for the development and maintenance of tracking behavior in monkeys. Aviat Space Environ Med 1980:51:121-125

12. Bachman JA, Jaeger RJ, Newsome TJ. Human and non-human operators in manual control systems. Aviat Space Environ Med 1980;47:612-617

13. Eidelberg E, Davis F. Role of proprioceptive data in performance of a complex visuomotor tracking task. Brain Res 1976;105:588-590

14. O'Mara PA, Stamper DA, Lund DJ. A microcomputer-controlled video electronic system for measuring human pursuit tracking performance. Presidio of San Francisco, CA: Letterman Army Institute of Research, 1981. LAIR Institute Report No. 90

15. Landis C, Hunt WA. Startle pattern. Reprint of 1939 ed. New York: Johnson Reprint Corp, (no date):34-5, 146, 47-48

16. Herrick, RM. Foveal luminance discrimination as a function of the duration of the decrement or increment in luminance. J Comp Physiol Psych 1956;49:437-443

17. Edwards ALH. Rhesus tracking performance: Incoherent white light effects. Presidio of San Francisco, CA: Letterman Army Institute of Research, 1984. LAIR *Institute Report No. 178*

APPENDIX

digit3.bas 23-Aug-84 Page 1

```
10 REM ******************************************************
20 REM                 DIGIT3.BAS
30 REM               REV 23 AUG 84
40 REM              VICTOR J. PRIBYL
50 :
60 REM        FOR USE WITH HEATH H-8, BASIC-80 4.7,HDOS 1.5
70 REM ******************************************************
80 :
90 :
100 DIM IX(400),IY(400),IS(400)
110 LINE INPUT "NAME OF OUTPUT FILE?"; F$
120 INPUT "FOR CONTINUOUS DISPLAY TYPE 1";CO
130 :
140 :
150 REM --->   INITIALIZE 8253, IC200 (SYNCH. SEPARATOR/X-WINDOW)
160 :
170 OUT 19,18:OUT 19,82:OUT 19,146
180 :
190 :
200 REM ----> SYNCH WINDOW (2MHZ CLK)
210 :
220 OUT 16,140
230 :
240 :
250 REM ---->   X-WINDOW
260 :
270 OUT 17,1
280 :
290 :
300 REM ---->   X-WINDOW
310 :
320 OUT18,34
330 :
340 :
350 REM ---->   INITIALIZE 8253, IC201 (Y-WINDOW/YCOUNTER)
360 :
370 OUT 11,18:OUT 11,82:OUT 11,148
380 :
390 :
400 REM ---->   Y-DELAY
410 :
420 OUT 8,25
430 :
440 :
450 REM ---->   REM Y-WINDOW
460 :
470 OUT 9,225
480 :
490 :
500 REM ---->   REM Y- COUNTER
510 :
520 OUT 10,255
530 :
540 :
550 REM ---->   GROUP A=MODE1, STROBED INPUT
560 REM ---->   GROUP B=MODE 0, PORT B OUT, PORT C IN
570 :
```

```
580 OUT 3,185
590 :
600 :
610 REM ----> SET PC2 TO CLEAR IC217
620 :
630 OUT 3,5:OUT 2,4
640 :
650 :
660 REM ----> SET PC5 TO ENABLE IBF OUTPUT
670 :
680 OUT 3,11
690 :
700 :
710 REM ----> OPTION INPUT LOOP 2
720 REM ----> CLEAR IC217
730 :
740 OUT 1,0:OUT 1,1
750 :
760 :
770 REM ----> DATA LOOP
780 :
790 FOR I=1 TO 300
800 IY(I)=INP(10):IS(I)=INP(2):IX(I)=4*(IS AND 192)+INP(0)
810 M=0:IF(IS(ILIST
820 J=I-1
830 IF (IS(I) AND 32)=0 THEN PRINT "NO TARGET"
840 IF CO<>1 THEN GOTO 890
850 IF (IS(I) AND 32)=0 THEN IY(I)=IY(J)
860 IF CO<>1 THEN GOTO 890
870 PRINT IX(I),IY(I),M,I
880 GOTO 900
890 PRINT IY(I),M
900 NEXT I
910 IF CO=1 THEN GOTO 710
920 OPEN "O",#1,F$
930 FOR I=1 TO 300
940 M=0:IF (IS(I) AND 2)=0 THEN M=?
950 IF (IS(I) AND 2)=1 THEN M=1
960 J=I-1
970 IF (IS(I) AND 32) =0 THEN PRINT "NO TARGET"
980 IF (IS(I) AND 32)=0 THEN IY(I)=IY(J)
990 IX(I)=M
1000 PRINT IX(I),IY(I),M,I
1010 PRINT #1,IX(I),IY(I)
1020 NEXT I
1030 CLOSE
1040 END
```

plot2.bas 23-Aug-84 Page 1

```
10 REM ******************************************************
20 REM                  plotmt.bas
30 REM                 rev 23 aug 84
40 REM                 Victor J. Pribyl
50 RENUM
60 REM  FOR USE WITH HEATH H-8, BASIC-80 1.7, AND HDOS 1.5
70 REM ************************************************************
80 REM
90 :
100 REM: WRITTEN SEPTEMBER 13,1982 BY VICTOR PRIBYL
110 :
120 :
130 REM: ---->   INITIALIZING STATEMENTS
140 :
150 DIM M(300),IY(300),JX(17),JY(17),XER(300),JFLASH(40)
160 Z$="#### ####"
170 Y$="####### ##### ####### ##### ####### ##### ####### ##### ####### #####"
180 TRIAL=1
190 PRINT "LP: AND HP: MUST BE LOADED"
200 GOTO 230
210 OPEN "O",#3,"HP:"
220 OPEN "O",#2,"LP:"
230 CLOSE
240 :
250 :
260 REM---->   POPULATE AXES
270 :
280 FOR I=1 TO 17: READ JX(I),JY(I):NEXT I
290 DATA 100,1428,0,1428,0,4285,100,4285
300 DATA 0,2857,3000,2857,5999,2857,9999,2857
310 DATA 100,5714,0,5714,0,7142,0,8570,100,8570
320 DATA 0,7142,3000,7142,5999,7142,9999,7142
330 :
340 :
350 REM: ---->   INPUT FILENAME, ZERO VALUES, VALUE FOR 15 MR.
360 :
370 LINE INPUT "WHAT IS THE NAME OF THE DATA FILE?";F$
380 OPEN "I",#1,F$
390 CLOSE
400 INPUT "WHAT IS THE VALUE OF ZERO (CENTERED)?";ZERO
410 INPUT "WHAT IS THE VALUE OF 15 MILLIRADIANS?";XMR
420 :
430 :
440 REM: ---->   15 MILLIRADIANS = 1 INCH; 3 SECONDS = 1 INCH
450 :
460 PL=0
470 INPUT "TO PLOT DATA TYPE 1";PL
480 INPUT "FOR SHUTTER TRIAL TYPE 1";SH
490 :
500 :
510 REM: ---->   PLOT AXES
520 :
530 OPEN "O",#3,"HP:"
540 IF PL<>1 THEN GOTO 670
550 IF TRIAL-1 GOTO 610
560 PRINT #3, "PLTL"
570 FOR I=1 TO 4:PRINT #3,USING Z$;JX(I),JY(I):NEXT I
```

```
580 PRINT #3,"       PLTT":PRINT #3,"PLTL"
590 FOR I=5 TO 8:PRINT #3,USING Z$;JX(I),JY(I):NEXT I
600 PRINT #3,"       PLTT"
610 IF TRIAL-2 GOTO 670
620 PRINT #3,"PLTL"
630 FOR I=9 TO 13:PRINT #3,USING Z$;JX(I),JY(I):NEXT I
640 PRINT #3,"       PLTT":PRINT #3,"PLTL"
650 FOR I=14 TO 17: PRINT #3,USING Z$;JX(I),JY(I):NEXT I
660 PRINT #3,"       PLTT"
670 :
680 :
690 REM: ---->  INPUT, TRANSFORM, PLOT AND PRINT DATA
700 :
710 T=TRIAL
720 IF T=1 THEN K=2857
730 IF T=2 THEN K=7142
740 PRINT "K=",K
750 OPEN "I",#1,F$
760 PRINT #3,"PLTL"
770 J=0
780 FOR I=1 TO 300
790 INPUT #1,M(I),IY(I)
800 PRINT M(I),IY(I)
810 TIME =I*333.3/10
820 RMS=(IY(I)-ZERO)/XMR*1428.5+K
830 IF PL<>1 THEN GOTO 870
840 IF M(I)=0 THEN J=J+1
850 IF M(I)=0 THEN JFLASH(J)=I
860 PRINT #3,USING Z$;INT(TIME),INT(RMS)
870 NEXT I
880 PRINT #3,"       PLTT"
890 IF J=0 THEN GOTO 1050
900 IF SH<>1 THEN GOTO 960
910 PRINT #3,"PLTL"
920 TIME =JFLASH(J)*333.3/10
930 PRINT #3,USING Z$;INT(TIME);INT(K+250)
940 PRINT #3,USING Z$;INT(TIME);INT(K-250)
950 PRINT #3,"       PLTT"
960 PRINT #3,"PLTL"
970 TIME =JFLASH(1)*333.3/10
980 PRINT #3,USING Z$;INT(TIME):INT(K+250)
990 PRINT #3,USING Z$;INT(TIME);INT(K-250)
1000 PRINT #3,"       PLTT"
1010 :
1020 :
1030 REM: ---->  OPTION TO PRINT RAW DATA
1040 :
1050 INPUT "TO PRINT RAW DATA TYPE 1";PR
1060 IF PR<>1 THEN GOTO 1150
1070 OPEN "O",#2,"LP:"
1080 FOR I=1 TO 60
1090 J=I+60
1100 K=I+120
1110 L=I+180
1120 M=I+240
1130 PRINT #2,USING Y$;I,IY(I),J,IY(J),K,IY(K),L,IY(L),M,IY(M)
1140 NEXT I
```

```
1150 CLOSE
1160 :
1170 :
1180 REM: ---->   STATISTICAL ANALYSES
1190 :
1200 INPUT "START WITH WITH SECOND?";START
1210 INPUT "WHAT IS LAST SECOND?";X2
1220 START=10*(START-1)+1
1230 X2=10*X2
1240 :
1250 :
1260 REM: ---->   COMPUTE POSITION IN MILLIRADIANS
1270 :
1280 J=0
1290 TER=0
1300 TSQ=0
1310 FOR I=START TO X2
1320 XER(I)=(IY(I)-ZERO)*15/XMR
1330 J=J+1
1340 TER=TER+XER(I)
1350 TSQ=TSQ+XER(I)*XER(I)
1360 GOTO 1380
1370 PRINT "I=";I,"XER(I)=";XER(I),"J=";J,"IY(I)=";IY(I),"TER=";TER,"TSQ=";TSQ
1380 NEXT I
1390 PRINT "TER=";TER,"J=";J
1400 CP=TER/J
1410 TSQ=ABS(TSQ)
1420 RMS=SQR(TSQ/J)
1430 TER=0
1440 J=0
1450 FOR I=START TO X2
1460 J=J+1
1470 TER=TER+(XER(I)-CP)*(XER(I)-CP)
1480 NEXT I
1490 SD=SQR(TER/J)
1500 PRINT "CP= ";CP,"RMS=";RMS,"SD=";SD
1510 AL=0
1520 INPUT "FOR ANOTHER ANALYSIS TYPE 1";AL
1530 IF AL=1 THEN GOTO 1180
1540 :
1550 :
1560 REM: OPTION FOR SECOND TRIAL
1570 :
1580 IF TRIAL=2 THEN STOP
1590 INPUT"FOR SECOND TRIAL TYPE 2.";TRIAL
1600 IF TRIAL<>2 THEN STOP
1610 GOTO 350
1620 END
```

```
10 REM ****************************************************
20 REM                    TRACK1.BAS
30 REM                    REV 23 AUG 84
40 REM                    VICTOR PRIBYL
50 REM
60 REM      FOR USE WITH HEATH H-8, BASIC-80, AND CP/M 1.43
70 REM ****************************************************
80 REM
90 REM ---->  INITIALIZE REINFORCEMENT
100 REM
110 OUT 24,255
120 REM ---->  INITIALIZE OPERATING VALUES
130 REM
140 DEFINT I-N
150 PRINT "TYPE NUMBER OF SECONDS "
160 INPUT SIZE
170 SIZE = SIZE * 10.8696
180 NSIZE = SIZE
190 DIM JRAY(NSIZE)
200 PRINT "type percent time on target"
210 INPUT M
220 L=(NSIZE *M)/100
230 PRINT "TARGET SCORE =",L
240 PRINT "ready-cr to proceed;22 to stop"
250 INPUT B
260 IF B=22 GOTO 570
270 NTOT =0
280 FOR I=1 TO NSIZE
290 JRAY(I)=0
300 NEXT I
310 I=0
320 REM ---->  LOOP TO INPUT ON TARGET INFORMATION
325 REM
330 IA=INP(16)
340 IA=(IA AND 1)
350 I=I+1
360 IF I>NSIZE THEN PRINT "i=",I,"ntot=",NTOT
370 IF I>NSIZE THEN I=I-NSIZE
380 NTOT =NTOT-JRAY(I)
390 JRAY(I)=IA
400 NTOT=NTOT+JRAY(I)
410 PRINT "I=";I,"IA=";IA,"NTOT=";NTOT
420 IF NTOT=L GOTO 480
430 IF NTOT>L GOTO 480
440 GOTO 330
450 REM
460 REM ---->  CONTROLS REINFORCEMENT
470 REM
480 OUT 24,0
490 PRINT "REINF ON"
500 FOR I=1 TO 500
510 Z=Z+2
520 NEXT I
530 PRINT "REINF OFF"
540 PRINT NTOT
550 OUT 24,255
560 GOTO 240
570 STOP
580 END
```

END

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